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The VELVETBEAN



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THE VELVETBEAN, a summer annual, in recent years has become an important factor in the development of the livestock industry and as a soil-improving crop in the Southern States. As the feeding value is not seriously reduced by exposure in the field during the winter months, it is a valuable plant for grazing from late fall until early spring. The seeds have a high feeding value and are of importance as a concentrated feed, while the leaves and vines afford good roughage. A mixture of velvetbeans and corn silage is regarded as a better feed than silage from corn alone. For soil improvement, especially on sandy soils, the velvetbean is one of the best crops, giving heavy yields at low cost.

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THE VELVETBEAN

By C. V. PIPER, *agronomist in charge*, and W. J. MORSE, *agronomist*, Division of
Forage Crops and Diseases, Bureau of Plant Industry

Revised by W. J. MORSE, *senior agronomist*

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DESCRIPTION

Velvetbeans are vigorous-growing annuals (fig. 1), the vines, with the exception of the bush varieties, usually attaining a length of 10 to 25 or more feet. The leaves are trifoliate, with large, ovate, membranous leaflets shorter than the petiole. The flowers of the different species and varieties vary in color from white to dark purple, are 1 to 1½ inches long, and are borne singly or in twos and threes in long pendent clusters.

The pods are of two distinct types, one being covered with a dense, black, velvety pubescence (hairiness), as in varieties of *Stizolobium deeringianum* Bort., and the other with white or grayish hairs, as in varieties of the Lyon velvetbean (*S. cochinchinensis*), Yokohama velvetbean (*S. hassjoo* Piper and Tracy), and the Chinese velvetbean (*S. cochinchinensis*). The pubescence, which sheds to a large extent soon after maturity, causes more or less skin irritation. The pods of some species are only 2 to 3 inches long, while those of others may reach a length of 5 to 6 inches. The species which commonly produce marbled seeds may produce occasionally within its varieties an entirely white or an entirely brown seed.

Velvetbeans have numerous rather fleshy surface roots, which are often 20 to 30 feet long and abundantly supplied with nodules.

HISTORY

Although the velvetbean has been grown for many years as an ornamental vine for porches and trellises, its value as a soil-improving and forage crop was not recognized until the latter part of the nine-

teenth century. As early as 1890 a variety of *Stizolobium deeringianum* was used to some extent for green manure in citrus orchards in Florida. This variety, known as the Florida velvetbean, seldom matured more than a few pods when grown north of the most southern portions of Georgia, Alabama, and Mississippi, where it was grown for a long time as a grazing and green-manure crop. Through the introduction of new species, hybridization, and selection, several



FIGURE 1.—A young plant of velvetbean.

promising early varieties have been developed, with the result that the successful production of the velvetbean has extended northward until it is now grown practically throughout the Cotton Belt (fig. 2). Prior to this the velvetbean was grown mainly in Florida and probably never exceeded 700,000 acres in any year.

Although many other factors contributed to the rapid increase in the acreage of velvetbeans in the Gulf States, the most important undoubtedly was the serious damage by the cotton boll weevil, which necessitated changes in farm practices.

Most of the varieties now on the market make considerable growth as far north as the Ohio River, but north of the southern boundary of Tennessee in the piedmont section and north of southeastern Virginia

in the Coastal Plain seeds mature only in years with favorable growing seasons and late fall frosts. There the velvetbean should be grown primarily as a green-manure crop.

The extent of the culture and the increase in the production of the velvetbean are shown in table 1.

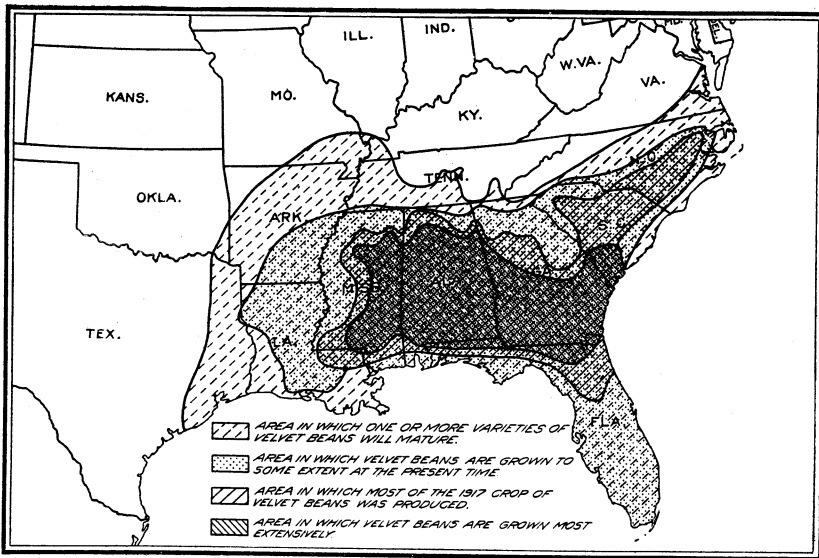


FIGURE 2.—Map of the southeastern United States, showing the distribution of velvetbeans.

TABLE 1.—Acreage and production of velvetbeans 1921, average 1928-32, and 1936¹

State	Acreage			Production		
	1921	Average 1928-32	1936	1921	Average 1928-32	1936
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>
Alabama.....	838,000	352,000	623,000	1,085,000	136,000	249,000
Florida.....	252,000	156,000	180,000	150,000	58,000	50,000
Georgia.....	780,000	748,000	1,188,000	436,000	315,000	475,000
Louisiana.....	254,000	40,000	66,000	182,250	17,000	25,000
Mississippi.....	300,000	53,000	102,000	120,000	30,000	56,000
South Carolina.....	250,000	65,000	77,000	125,000	31,000	40,000
Total.....	2,674,000	1,414,000	2,236,000	2,098,250	587,000	895,000

¹ Agricultural Statistics, 1936.

SPECIES AND VARIETIES

The Florida velvetbean was the only species grown in the United States until about 1906, at which time the Department of Agriculture began the introduction of species from various parts of the world. About 20 species and varieties were introduced, including the Chinese, the Lyon, and the Yokohama, while several early types, such as the Georgia, Alabama, and Arlington, were selected from the Florida variety. At the present time the total acreage devoted to the velvetbean consists largely of early maturing varieties which differ principally in growth of vine; color of flowers; size, shape, and pubescence of pods; size, shape, and color of seeds; and time of maturing.

The Florida velvetbean makes a very rank growth of vine and requires a frost-free period of 8 or 9 months to mature. The purple flowers are borne in clusters 3 to 8 inches long. The pods are 2 to 3 inches long, nearly straight, blunt at each end, and covered with a

black velvety pubescence (fig. 3). The seeds are nearly spherical, about three-eighths of an inch in diameter, and usually grayish, marbled with brown (fig. 4). White seeds are produced occasionally, and a white-seeded variety has been isolated, but it has shown no special superiority over the variety with mottled seeds.

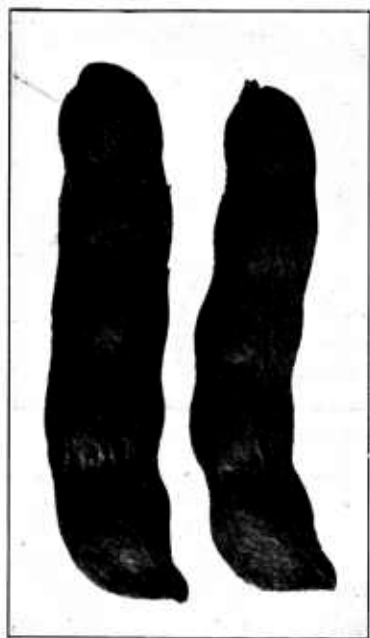


FIGURE 3.—Mature pods of the Florida velvetbean.

The Alabama velvetbean is very similar to the Georgia variety except that it makes a more vigorous growth and matures about 6 weeks later. It is best adapted to the region south of central Georgia, Alabama, and Mississippi. In that region it is the principal variety, having replaced the Georgia variety almost entirely, chiefly under the names "Early Speckled" or "Hundred-Day Speckled."

The Arlington velvetbean is an early selection from the Georgia variety, made at Arlington Experiment Farm, Arlington, Va. The two are similar in all respects except that the Arlington matures earlier and makes less vine growth. This variety is one of the earliest velvetbeans and has matured seed as far north as Washington, D. C.

The Georgia velvetbean, the first early maturing variety, was discovered in 1906 by Clyde Chapman at Sumner, Ga. In 1908 another early maturing variety resembling in every

respect the one discovered by Chapman was found in a field of Florida velvetbeans by R. W. Miller at Broxton, Ga. These early maturing plants were named the Georgia velvetbean (fig. 5). This variety makes a much less vigorous growth and yields somewhat less seed than the Florida variety but otherwise is practically the same. The Georgia variety matures in 110 to 130 days and is adapted to all parts of the Cotton Belt. It has also been called "Ninety-Day Speckled," "Hundred-Day Speckled," and "Early Speckled," names later transferred to the Alabama variety. This variety is grown less extensively than formerly, having proved inferior to the somewhat later Alabama variety.

The Bush or Bunch velvetbean, a nonvining sport of the Florida variety, was developed from a single plant on the farm of Roan



FIGURE 4.—Seeds of the Florida velvetbean (natural size).

Beaseley at Kite, Ga. It is a bushy type, branching near the base and ordinarily attaining a height of about 3 feet (fig. 6), with an occasional branch 5 to 6 feet in length, but having no vining tendency. Clusters of pods form a dense mass near the base. The plant matures in about the same time as the Alabama variety but is less productive.

The Bush velvetbean was at one time very popular as a green-manure crop in orchards and was also grown quite extensively in corn, as the plants do not produce vines that weigh down the corn as do the vining sorts. The main objections to this variety are that the pods cannot be gathered so rapidly as those of the vining varieties, and as they lie so close to the ground they become water-soaked in wet weather, which causes many of them to decay. The popularity which this variety achieved shortly after its introduction decreased in later years chiefly because its seed could not be distinguished from that of the vining types, the Georgia, the Florida, and the Alabama, a considerable amount of which was sold as or mixed with seed of the Bush variety.

The Osceola velvetbean, a hybrid between the Florida and Lyon varieties developed at the Florida Agricultural Experiment Station, is a heavy seed producer. The white, or rarely purple, flowers are borne in rather short racemes.

The pods (fig. 7) are 4 to 5 inches long, flat, ridged

lengthwise, covered with a black velvety pubescence, and bear four to five, usually five, seeds. The seeds are slightly larger than those of the Lyon or Yokohama varieties and are usually marbled with brown, although occasionally white seeds are produced. The pods are free from stinging hairs and are more woody than those of the Alabama variety. This variety matures in 150 to 160 days, being earlier than the Florida and later than the Georgia, Alabama,



FIGURE 5.—A well-developed raceme of the Georgia velvetbean (one-half natural size).

Arlington, Tracy, and Yokohama varieties. It is adapted to the region south of a line running through the center of Georgia, Alabama, and Mississippi.

The Lyon velvetbean was introduced in 1907, the first specimens being obtained from Pampanga Province, Luzon, Philippine Islands. This variety makes a vigorous growth and requires a long season to mature, seldom ripening more than 10 days earlier than the Florida variety. The white flowers are borne in pendent racemes which are often 2 to 3 feet long. The woody pods (fig. 8) are 5 to 6 inches long, compressed, ridged lengthwise, covered with a fine grayish pubescence,



FIGURE 6.—Typical plant of the Bush or Bunch velvetbean.

and have a tendency to shatter while still in the field. The ash-colored seeds are similar in size and shape to seeds of the lima bean.

The Chinese velvetbean was introduced from Tehwa, China, in 1909. In nearly all respects this variety is like the Lyon but is less vigorous. The Chinese velvetbean is about 6 weeks earlier than either the Lyon or the Florida, usually ripening before frost south of central Georgia, Alabama, and Mississippi.

The Yokohama velvetbean, obtained from Yokohama, Japan, in 1909, under the Japanese names "Osharaku-mame" and "Hassho-mame," produces a smaller vine growth than any of the other species and is not a heavy yielder. It is an early variety, maturing within 110 to 120 days. The purple flowers are borne in short racemes. The

Pods are 4 to 6 inches long, flat, quite pointed at each end, and covered with rather long gray pubescence. The seeds are ash-colored, oblong, compressed, and about two-thirds of an inch long. This species has several undesirable characters and is grown very little at the present time. Many of the pods form so close to the ground that they become water-soaked with each heavy rain and shatter in hot, dry weather.

The Tracy Black velvetbean, an early black-seeded hybrid selection developed by the late S. M. Tracy, Biloxi, Miss., is of about the same maturity as the Arlington, but is more prolific than other varieties. The beans are shiny black, flat, and about the size of those of the Osceola variety. Both beans and pods are somewhat softer than those of other varieties.

SOIL PREFERENCES

The greatest acreage of velvetbeans is found in the well-drained, sandy Coastal Plain soils of the South Atlantic and Gulf States, where conditions are especially adapted to the crop. They can be successfully grown on newly cleared land as well as on land that has been cultivated many years. The velvetbean has been used extensively as a green-manure crop on cut-over pineland and on sandy soils.

Velvetbeans make a good growth on clay soils in the northern portion of the Cotton Belt, but it is questionable whether they will do better than cowpeas on the poorer soils in this area. Velvetbeans will not succeed on cold, wet soils and should never be planted before the soil has become thoroughly warm.

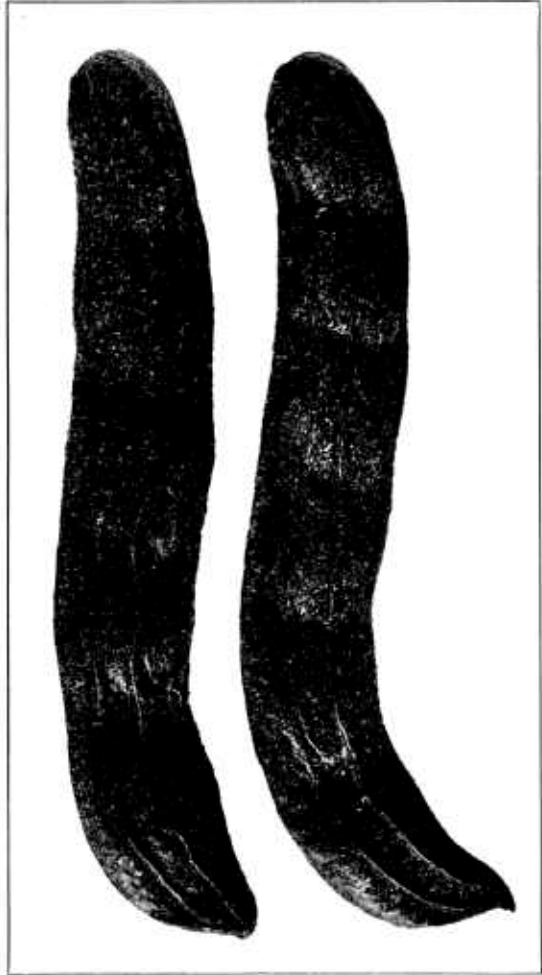


FIGURE 7.—Mature pods of the Osceola velvetbean (natural size).

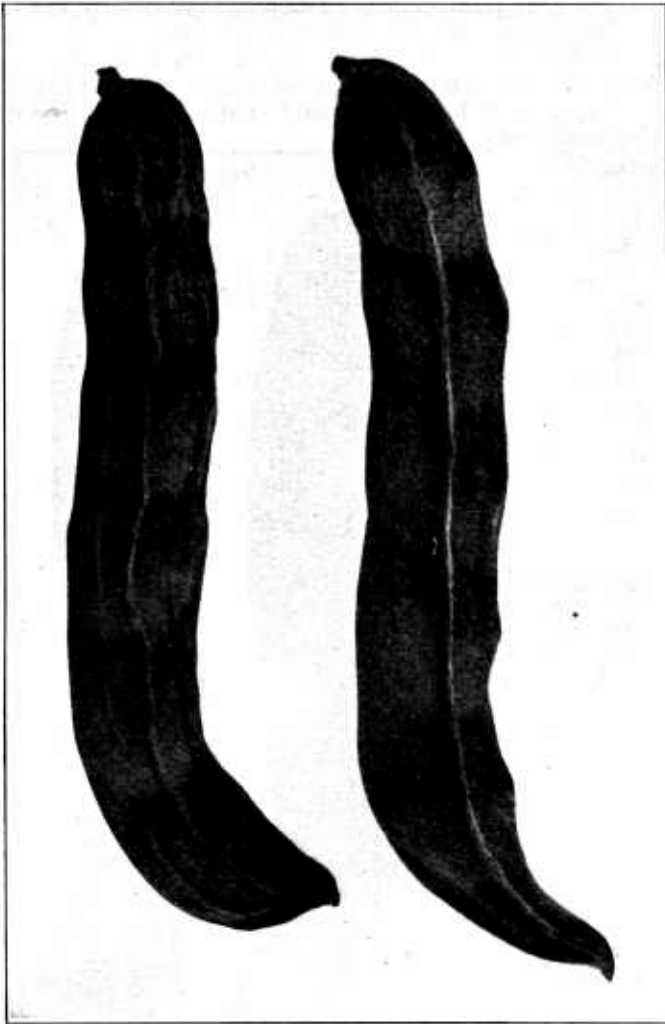


FIGURE 8.—Pod of the Lyon velvetbean on the left and of the Yokohama velvetbean on the right (natural size).

ROTATIONS

The Florida Agricultural Experiment Station conducted a series of experiments to determine the effect on the yield of velvetbeans when grown on the same land continuously for a number of years. While continuous cropping to velvetbeans did not affect the vegetative growth from year to year, it did result in decreased seed yields. These yields, when compared with those from check plots where the velvetbeans were grown in rotation, showed a decrease amounting to 8 bushels per acre. Experiments at Biloxi, Miss., showed similar results, which indicated that it is not advisable to grow velvetbeans continuously on the same land for seed production. If, however, they are

grown for soil improvement and the production of seed is a secondary consideration, there seems to be no objection to continuous cropping.

The beneficial effects of velvetbeans on succeeding crops, either when cut for hay or when the whole plant is turned under, has been demonstrated by a number of experiments. For this reason it is much better to plant some nonleguminous crop after velvetbeans have been grown 1 or 2 years. At the Alabama Agricultural Experiment Station the seed-cotton yield per acre after cotton was 918 pounds; after velvetbeans cut for hay, 1,126 pounds, and after velvetbeans plowed under, 1,578 pounds. Corn was planted on these plots the following year, and the plot that had yielded 918 pounds of cotton per acre produced 18 bushels of corn whereas the plot that had yielded 1,578 pounds of cotton per acre produced 25.5 bushels of corn. In another test at this station the yield per acre of corn following corn was 13.5 bushels; after velvetbean stubble, 17.9 bushels; and after velvetbeans plowed under, 25.9 bushels. The velvetbeans were planted after oat stubble was plowed under. At the Arkansas Agricultural Experiment Station the seed-cotton yield per acre after cowpeas, soybeans, and velvetbeans plowed under was 1,355 pounds, 1,488 pounds, and 1,550 pounds, respectively.

FERTILIZERS

Although velvetbeans make a fair growth on poor soils, it is sometimes advisable to apply a small amount of fertilizer at the time of seeding, the kind and quantity being about the same as for corn.

Velvetbeans, through the root nodules, are able to obtain nitrogen from the air, much of which is returned to the soil when only the pods are harvested or when the crop is pastured and the roots and uneaten portions of the plants are allowed to decay. At the branch experiment station at McNeill, Miss., phosphatic fertilizers are necessary to obtain good yields, and on the basis of experimental results 100 to 200 pounds per acre are recommended. The addition of cottonseed meal at the rate of 200 pounds per acre gave an increased yield of 280 pounds of beans per acre as compared with the yield when 200 pounds per acre of acid phosphate alone was used. At the Florida station no increased yield was obtained from fertilizers applied singly or in various mixtures. The velvetbean is not sensitive to sour soils but is helped by lime.

INOCULATION

Inoculation seems unnecessary for velvetbeans, as apparently all of the velvetbean area is provided with the organism that forms nodules on the roots of the plants. No lack of root nodules seems to occur when they are planted on land for the first time, but instances have been noted where the growth of the vines has been materially increased by inoculation.

The same strain of the organism that inoculates lima beans, cowpeas, and lespedeza also inoculates velvetbeans. As lespedeza grows abundantly over much of the South, and as cowpeas have been planted widely for many years in all of the velvetbean area, it is easy to understand why the velvetbean has succeeded so well without artificial inoculation. The large acreages of velvetbeans planted during recent years have served also to increase its inoculating organisms.

PREPARATION OF THE SEEDBED

Although the velvetbean is easy to raise, the best results are obtained on a well-prepared seedbed. In general, the land should be prepared as for corn. The ground should be plowed thoroughly to a depth of about 6 inches in December or January and harrowed at intervals before planting to kill the weeds.

TIME OF SEEDING

Velvetbeans will not germinate well in cold or wet soils, and as the young plants are very susceptible to injury by frost, planting should be delayed until all danger of frost is past. The average length of the growing season can be approximately determined from the frost lines shown in figure 9, and this, together with the time required for the

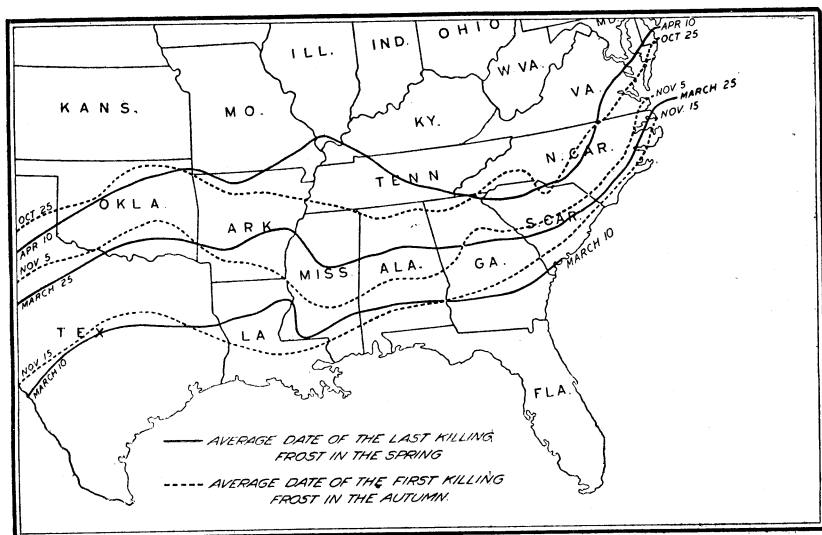


FIGURE 9.—Map of the southeastern part of the United States, showing the average dates of the last killing frost in the spring and the first killing frost in the autumn. The three sets of lines represent the approximate northern limit of the late, medium-early, and early maturing varieties of velvetbeans.

different types to mature, should give an idea as to the best time of planting. The length of time required for the ripening of any variety will vary with time of planting.

In the northern part of the Cotton Belt the seed should be planted early, or at corn-planting time. In the southern part of the Gulf States late varieties should be planted as soon as the soil is in good condition so that the plants will have time to mature before frost, but with early varieties the date of planting may extend over a period of 6 weeks or 2 months. In this section the planting of early varieties too soon is undesirable, as the beans mature so early that the pods split and shatter, and the foliage sheds before the corn is gathered and the stock can be turned into the field. If the crop is to be pastured, many farmers prefer to have the beans frosted before all of the pods are matured rather than to have them mature too early.

As most of the beans are grown with corn, it is better in general to grow varieties that can be planted with the corn and mature at the

desired time. When late varieties are to be grown, the beans should be planted at the same time as the corn, but when early varieties are used, especially in the southern part of the Cotton Belt, it is best to plant the beans by hand in the corn rows some time after planting the corn. On productive soils the method of planting two rows of corn and one row of beans is used extensively, and when an early variety of velvetbean is used, it may be planted later with little additional expense. On less productive soil, velvetbeans should be planted in each corn row. Labor is saved by using a planter that will place both seeds in the same row at one operation.

METHODS OF SEEDING

Velvetbeans, with the exception of the Bush variety, should be planted with a supporting crop. Corn, pearl millet, Japanese sugar-



FIGURE 10.—A field of corn and velvetbeans in which the beans were planted in every row of corn.

cane, sorghum, and other strong-growing plants are used for this purpose, but as corn (fig. 10) is an important crop in the velvetbean area, it is generally preferred. The yield of corn is decreased by the beans, depending largely on the rate and date of planting the beans and also the fertility of the soil. When corn is planted several weeks earlier than the beans, little damage occurs as the vines do not make sufficient growth to pull it down before the ears are nearly mature. When late varieties are planted at the same time as corn on fairly fertile soil, the yield of corn is decreased by competition for plant food, and, furthermore, some of the corn is pulled down by the bean vines and may mold. Even though the yield of corn is decreased, the value of the beans for green manure or for feeding purposes will offset the loss to the corn crop. The cost of picking the corn, however, is greater when planted with velvetbeans than when planted alone.

When the corn is to be cut for silage or where the soil is so poor that the beans do not make a vigorous growth, they should be dropped by hand 15 to 24 inches apart in the row on poor soil and about twice that distance apart on fertile soil.

Planting corn and beans in separate rows is a popular method, especially planting every third row to beans. Where this method is used, the beans may be planted at the same time as the corn or at a later date, as the cultivation of the corn will not interfere with the planting and cultivation of the beans. Even though the corn and beans are planted at the same time, the corn will have an opportunity to make considerable growth before the bean vines have developed sufficiently to twine about the stalks. In addition to this advantage, the gathering of the corn is made easier, as the vines do not make much growth between the two adjacent rows of corn and the person gathering the corn may easily walk between these rows. If the beans are planted in every row or in every other row, however, the vines are likely to form such a tangled mass that it is difficult to gather the corn.

Many farmers who feed hogs extensively plant alternate rows of peanuts and corn, with velvetbeans in the corn rows, and pasture the entire crop. On land where peanuts do well, this combination yields an abundance of feed of a well-balanced ration and will produce a better quality of pork than a feed of either peanuts or velvetbeans alone with corn.

RATE OF SEEDING

The rate of seeding will vary with the purpose for which the crop is grown and with the variety. If planted with corn and if it is desired to secure as much corn as possible, from 2 to 3 quarts to the acre will be sufficient for the Florida, Georgia, Alabama, and Arlington varieties. If a heavy crop of beans is desired and if the corn is not of first importance, twice as much seed should be used. For the large-seeded varieties, like the Osceola, the planting rate should be nearly doubled. If the heaviest possible growth of vines is desired, either for green manure or as a smother crop, from 30 to 60 pounds of seed should be used. Planting in the pod usually results in irregular germination and stands because of the failure of some of the pods to open.

CULTIVATION

Cultivation of velvetbeans during the early growing period will increase the yield sufficiently to more than pay the cost and should be continued until the plants begin to put out long runners, after which the ground will be covered so completely as to smother all weeds. When grown with corn, cultivation should be the same as for corn alone until the vines are so long that they are likely to be injured.

HARVESTING

The time of harvesting velvetbeans depends largely on the variety and use to be made of the crop. Late varieties to be used for pasture may be left in the field all winter. Early varieties should be pastured very soon after the beans mature, because mature pods are likely to shatter. When grown for seed, the entire crop should be harvested as soon as practicable after the pods mature. Immature or damp pods heat and mold when stored in bulk unless thoroughly stirred at frequent intervals. Because of the extensive tangled growth of

vines, hand-picking is necessary; the cost varies according to the variety and available labor. For the average laborer, 500 to 700 pounds of beans in the pod constitute a day's picking. As pickers usually leave many of the pods, stock should be turned into the field after harvest to consume the vines and the beans not gathered.

THRESHING

When velvetbeans are to be fed, whole or ground, to cattle, it is preferable to feed both hulls and beans. For this reason the quantity of beans threshed is ordinarily limited to those which are to be used or sold for planting purposes.

The beans may be threshed with a flail or with one of the several threshing machines now on the market. Regardless of the method, only well matured and thoroughly dried pods can be threshed without difficulty. If the quantity to be threshed is small, the pods may be sunned a few hours, put in an ordinary corn sack, and the beans beaten out with a club. For larger quantities, it is better to use one of the machines designed for the purpose. Small hullers which can be run by hand have sufficient capacity to enable a man and a boy to thresh 10 to 15 bushels a day. By making a few changes, machines equipped with cylinders and screen to pick peanuts or to shell corn may be successfully used for threshing velvetbeans. Small grain threshers may also be used by removing part or all of the concaves and reducing the speed of the cylinders about one-half without decreasing the speed of the rear parts of the machine. Without special screens, such machines do not properly clean the beans.

YIELDS OF VELVETBEANS

Many factors, including soil fertility, cultivation, and weather conditions, influence the yield of seed. On fairly rich soil the early varieties should produce 1,500 pounds of beans in the pods to the acre and the late varieties 2,000 pounds, whereas 3,000 pounds is not an unusual yield.

One ton of pods will produce 20 to 22 bushels of shelled beans, depending on the variety and the amount of moisture in the pods. With varieties like the Alabama and Florida, 90 to 95 pounds of pods will usually thresh out a bushel (60 pounds) of shelled beans, whereas the larger and coarser podded varieties require 100 pounds of pods to produce a bushel of shelled beans.

UTILIZATION OF VELVETBEANS

The vigorous growth of velvetbeans, together with their large yield of seed, which may be gathered or allowed to remain in the field without much injury during the autumn and winter, permits this crop to be utilized in a number of different ways. As an annual summer green-manure crop it is one of the best. Its value as feed for stock is quite generally recognized in the South, where large quantities are used for this purpose. The value of velvetbeans as a winter pasture, either for carrying cattle through the winter or for fattening them, is well established. Feeding experiments indicate that but little benefit is derived from grinding the beans for cattle, and it is very probable that the use of this crop for winter grazing will replace to a large extent the picking of the beans for grinding. The crop may also be used for silage and hay.

VELVETBEANS AS MEAL

In the manufacture of velvetbean meal¹ the beans and pods are ground, or, rather, crushed together by especially designed machinery. Although no standard of fineness has been established, a meal of the fineness of corn meal is preferred especially in the manufacture of mixed feeds. Some mills kiln-dry all beans before grinding, a practice which adds to the cost of manufacture but is necessary early in the season in order to keep the meal from spoiling.

Velvetbeans may be ground alone or with other feeds, but when they are ground alone the meal should be fed in combination with other feeds. A common mixture is obtained by grinding velvetbeans and corn in the shuck together. In accordance with the use to be made of the feed, velvetbean meal is used in varying proportions in the manufacture of mixed feeds. In horse feeds it seldom forms more than 25 percent of the mixture, whereas for dairy cows it may run as high as 70 percent. A popular mixed feed for dairy purposes is composed of 15 percent cottonseed meal, 45 percent corn-and-cob meal, and 40 percent velvetbean meal, while a popular feed for horses contains in addition to the velvetbean meal, corn, oats, and ground hay or straw.

VELVETBEANS AS HAY

Velvetbeans are seldom used for hay because of the difficulty in handling the long tangled vines. When used for this purpose it is necessary to cut the vines before many of the pods mature in order to save the leaves, which shatter rapidly on the approach of maturity. The hay is coarse and rough at best and is not relished by horses and mules. Yields of 2 to 3 tons per acre may be obtained.

VELVETBEANS AS SILAGE

Velvetbeans, particularly the early varieties, and corn have been used to some extent for silage. Most of the vine growth of the early varieties is wrapped about the cornstalks, and little trouble is experienced in cutting the corn with corn knives and in running it through the silage cutter. Silage made from this mixture turns black after it has been in the silo for a short time, because of the juices in the velvetbean plants, but this condition apparently does not impair its keeping qualities or feeding value. Corn-and-velvetbean silage is as palatable as corn silage, and dairymen who have fed silage made from the mixture prefer it to corn silage.

Table 2 gives analyses of corn-and-velvetbean silage as compared with silage made from well-matured corn.

TABLE 2.—*Composition of corn-and-velvetbean silage, velvetbean silage, and silage made from well-matured dent corn*

Kind of silage	Analyses	Water	Ash	Protein	Nitrogen-free extract	Fiber	Fat
	<i>Number</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Corn-and-velvetbean ¹	1	73.7	1.0	3.5	15.6	5.5	0.7
Corn (dent, well-matured) ²	248	71.7	1.7	2.3	16.5	6.9	.9
Velvetbean ²	1	76.4	1.1	4.3	9.0	8.0	1.2

¹ Analyzed by the Bureau of Chemistry and Soils, U. S. Department of Agriculture.

² Analyses taken from Morrison's Feeds and Feeding, Ed. 20, 1936.

¹ In this bulletin, "velvetbean meal" is used to designate the product of grinding the pods and beans together. When the beans are ground alone, the product is referred to as "ground velvetbeans."

VELVETBEANS AS PASTURE

The most important use of the velvetbean is as a grazing crop for cattle and hogs in the autumn and winter. It is never grazed readily by stock until well-matured or frosted. On sandy soils, the leaves, vines, and pods do not decay readily and often furnish feed until early spring. It is usually better to delay grazing until the crop is well-matured or killed by frost, as the leaves will be off the plants at that time and the corn may be gathered with less difficulty. The amount of grazing afforded will, of course, vary with the growth of the crop and the quantity of corn that is not gathered. Many cattlemen allow one-third to one-half acre per month for each steer or cow, the usual grazing period being about 3 months, but this may be shortened or lengthened as deemed advisable. When the acreage of beans is large and there are not sufficient cattle to stock the pasture at this rate, grazing is often continued for 4 or 5 months. When this is done, however, there is necessarily some loss through decay. Hogs should be allowed to follow the cattle to consume the beans which they have wasted. A common practice is to allow one or two hogs in addition to the cattle for each acre of beans. On the heavier soil types of the South there is some danger of packing the soil to the detriment of the succeeding crop if grazing is continued in rainy weather, and on such soils pasturing should be done with more care than on sandy soils. A good stand of velvetbeans should produce about 200 pounds of beef and 100 pounds of pork per acre.

VELVETBEANS USED FOR SOIL IMPROVEMENT

The velvetbean is one of the best soil-improving crops both for naturally poor soils and for those on which yields have decreased markedly. The ability of this plant to make a profitable growth on land so poor that most legumes do not thrive on it, places the velvetbean among the most important crops for the South. In addition to adding at a minimum cost large quantities of vegetable matter to the soil, thus making it more retentive of moisture, the nodules on the roots collect a large amount of nitrogen from the air. The nitrogen is left in the soil when the crop is turned under and the plants decay. Even though the crop is grazed, much of the nitrogen in the plants consumed by the stock will be returned to the soil in the manure.

In some sections velvetbeans have proved to be the most profitable crop to plant for 1 or 2 years on newly cleared land, as they not only supply considerable grazing or feed but also improve the soil for the crops that follow. The yield of seed from such ground is usually heavier than from fields which have been long in cultivation.

Investigations by the Alabama, Louisiana, and Florida Agricultural Experiment Stations give definite data as to the quantities of material added to the soil by velvetbeans. The results are shown in table 3. In interpreting this table it is well to remember that a ton of cottonseed meal contains about 130 pounds of nitrogen.

TABLE 3.—*Weights of dried and green material, roots, and nitrogen from 1 acre of velvetbeans*

Character of material	Alabama	Louisiana	Florida
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Green material.....	19,040.0	22,919.0	21,132.0
Dry material.....	8,240.0	7,495.0	5,953.0
Dried roots.....	1,258.0	191.0	690.0
Nitrogen in vines.....	201.3	170.0	131.5
Nitrogen in roots.....	12.6	2.9	9.7
Total nitrogen.....	213.9	172.9	41.2

VELVETBEANS AS A SMOTHERING CROP

When late varieties of velvetbeans are planted without a supporting crop they produce such a dense growth of vines that weeds, persistent grasses, and in many cases tree sprouts are smothered. The Florida station planted a freshly plowed field of strong Bermuda grass to velvetbeans. The following year this field was planted to cassava, and it remained entirely free from Bermuda grass. In the succeeding year, when planted to a cultivated crop, no trace of Bermuda grass was found.

FEEDING VALUE OF VELVETBEANS

Velvetbeans contain high percentages of protein and carbohydrates, constituents essential for growing stock and producing milk. The composition of velvetbeans and amount of digestible nutrients they contain as compared with those of other concentrated feeds are shown in table 4.

TABLE 4.—*Composition of velvetbeans and of velvetbean meal, compared with other feeds*¹

Material	Total dry matter	Protein	Fat	Fiber	Nitrogen-free extract	Mineral matter
	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Velvetbeans and pods (velvetbean meal).....	90.0	18.1	4.4	13.0	50.3	4.2
Velvetbean seeds.....	90.0	23.4	5.7	6.4	51.5	3.0
Velvetbean pods.....	89.0	5.1	.8	27.2	50.2	5.7
Wheat bran, all analyses.....	90.6	15.8	5.0	9.5	54.3	6.0
Cottonseed meal, 43-percent protein.....	93.5	43.2	7.2	10.6	27.0	5.5
Cottonseed meal, 45-percent protein and over.....	93.0	45.6	7.8	8.9	25.1	5.6
Corn, dent, well-dried.....	88.5	9.7	4.0	2.3	71.1	1.4
Corn, flint.....	88.5	9.8	4.3	1.9	71.0	1.5
Rice polish.....	90.5	12.7	11.5	3.0	57.2	6.1

¹ See footnote 2, table 2.

As velvetbeans are very high in digestible protein, great care should be exercised in feeding them to livestock, especially at first. After the stock become accustomed to the beans they should be kept in the field for only a short period each day until the crop is somewhat reduced, as excessive consumption is a waste of concentrated feed. In addition to wasting concentrated feed, overfeeding sometimes has a laxative effect similar to that caused by feeding too much cottonseed meal. For these reasons and because better gains will be obtained, velvetbeans should be fed in combination with other feeds. This is accom-

plished when cattle and hogs are pastured on corn and velvetbeans, as some corn will be overlooked in picking and the stover contains a relatively high proportion of carbohydrates.

Feeders who use velvetbean meal and ground beans find that a larger quantity of the former is needed to obtain the same results. It requires about $2\frac{1}{2}$ pounds of velvetbean meal or $1\frac{1}{2}$ pounds of ground beans to equal in feeding value 1 pound of high-grade cottonseed meal. It is not necessary to grind the pods and seeds for home consumption, as practically as good results are obtained from feeding them whole. If the pods have become dry, it is better, although not absolutely necessary, to soak them before feeding.

FOR BEEF CATTLE

Experiments carried on by the Bureau of Animal Industry of the United States Department of Agriculture in cooperation with the Mississippi station supplement practical experience in that velvetbeans are a good feed for fattening steers. General conclusions reached from these tests are: (1) Thin-podded varieties, similar to the Florida, are much higher in feeding value than those with very thick pods, which are relatively unpalatable; (2) dry whole velvetbeans are more economical for fattening steers than soaked whole velvetbeans if the labor cost of soaking is taken into consideration; (3) dry velvetbeans in the pod make a palatable ration without being soaked or ground; (4) ground velvetbeans heat quickly, become rancid, and mold readily; (5) both whole velvetbeans, either dry or soaked, are much more palatable than dry ground velvetbeans, which are so unpalatable that steers will not eat enough to make good gains; (6) cottonseed meal increases the palatability of a ration of velvetbeans; (7) although 2 pounds of velvetbeans are practically equal to 1 pound of cottonseed meal for producing gains in fattening steers and there is considerable saving in the amount of forage required, cottonseed meal is a more palatable feed and produces more rapid gains; (8) for fattening steers velvetbeans may be economically substituted for cottonseed meal when the price, delivered at the farm, does not exceed one-half the price for good-quality cottonseed meal; (9) hogs do not make satisfactory gains from the droppings alone when following steers that have been fed velvetbeans in any form.

Results obtained by the South Carolina station show that although cattle fed velvetbeans as the sole concentrate did not put on flesh as rapidly as cattle fed other concentrates, the cost per hundred pounds of gain in weight was appreciably less when the velvetbeans were used.

The Florida station found velvetbeans in the pod a very satisfactory feed for steers as a part of the ration. The daily gains were higher and the cost of the gains much less than with any of the other rations compared with them, including one of corn, cottonseed meal, and hay.

Further tests made by this station indicate that if cultivated fields are available for handling a farm herd of cattle, winter feed can often be provided by growing velvetbeans and corn and turning the cattle into the field during late fall and winter after the larger ears of corn have been harvested. It is generally considered that 1 acre managed in this way will carry one cow for 3 or 4 months.

At the Alabama station cottonseed meal was compared with velvetbeans in the pod, each being fed with corn silage. It was

found that from 2.05 to 2.46 pounds of velvetbeans equaled 1 pound of high-grade cottonseed meal, measured both by gains and by quality of meat. In a later trial 3.07 pounds of dry beans in the pods, 2.7 pounds of beans in the pods soaked in water, and 2.16 pounds of pods and beans ground into meal were each equal in feeding value to 1 pound of cottonseed meal.

At the Louisiana station, on 24 acres of cornstalks and velvetbeans, 31 calves made an average daily gain of 1.06 pounds per head during an 87-day period from November to February.

FOR DAIRY CATTLE

At the Florida station 816 pounds of velvetbeans in the pods fed with wheat bran and Japanese sugarcane silage produced 348.7 gallons of milk at a cost of 13.3 cents per gallon, while 576 pounds of cottonseed meal fed with wheat bran and more silage produced 352.5 gallons of milk at a cost of 16.5 cents per gallon. On this basis, velvetbeans in the pod are worth \$2.37 when cottonseed meal is worth \$2.40 per 100 pounds. In another test it was found that 267.75 pounds of velvetbeans in the pods fed with bran and silage produced 934.6 pounds of milk, while 94.5 pounds of cottonseed meal fed with bran and less silage produced 937.1 pounds of milk. From still later experiments it was concluded that when fed with bran and silage, 2 pounds of velvetbean meal were equal to 1 pound of cottonseed meal.

According to results obtained at the Georgia station, 2,035 pounds of velvetbean meal were equal to 2,000 pounds of cottonseed meal for milk production, and 5½ pounds of velvetbeans produced 1 pound of milk, whereas 5 pounds of cottonseed meal produced the same quantity.

At the Alabama station, during an experiment of 56 days, four cows consumed 1,370.9 pounds of velvetbeans, 913.9 pounds of corn, and 6,720 pounds of silage, and produced 3,252.4 pounds of milk at a cost of \$1.47 per 100 pounds. Four other cows consumed 678 pounds of cottonseed meal, 894 pounds of corn, and 6,700 pounds of silage and produced 3,418.1 pounds of milk at a cost of \$1.33 per 100 pounds.

The Massachusetts station conducted two experiments with groups of six and four cows, in which the ration consisted of hay and a grain ration of 20 percent of cottonseed meal, 40 percent of corn meal, and 40 percent of velvetbean meal or wheat bran. The results showed that the cows while receiving the velvetbean ration produced an average of 5 percent more milk than while on the wheat-bran ration. It was concluded that the velvetbean meal is somewhat superior to wheat bran for dairy purposes and that it may constitute as much as 40 percent of a dairy ration, together with a like quantity of corn or hominy meal or ground oats and some 20 percent of cottonseed or linseed meal or other high-grade protein concentrate.

At the Tennessee station equal quantities of cottonseed meal and velvetbean meal, fed at a rate of not more than 10 pounds a day, proved good feed for dairy cattle.

The South Carolina station conducted a series of experiments to compare the value of velvetbeans with that of other feeds and to determine the most economical and practical method of feeding them to dairy cows. It was found that velvetbean meal can be fed to dairy cows if it constitutes not more than 50 percent of the total grain mixture. Although velvetbeans are not greatly relished by the cows, as was indicated by the fact that the more velvetbean meal there was in

the mixture the less they consumed, no great trouble was experienced in getting cows to eat the 50-percent velvetbean meal mixture. A pound of a mixture 50 percent of which was velvetbean meal and 50 percent a two-part corn-meal, two-part wheat-bran, and one-part cottonseed-meal mixture, gave practically the same results as a pound of corn-meal, wheat-bran, or cottonseed-meal mixture. From the tests on the best method of feeding velvetbeans and other experiments with this feed, it is recommended that, wherever practicable, velvetbeans be ground for dairy cows.

FOR SWINE

While velvetbeans usually give good results with cattle and sheep, even when fed in considerable amounts, they are generally unsatisfactory for swine (either brood sows or growing and fattening pigs) when forming any considerable part of the ration and may even cause severe vomiting and diarrhea owing apparently to the presence of a substance poisonous to swine. This has been the case, no matter whether the beans have been fed shelled, ground, or as velvetbean meal. The toxicity is lessened and the digestibility increased by cooking. When velvetbeans do not form more than one-fourth of the ration and an efficient protein supplement like tankage or fish meal is included, fair results may be obtained.

At the Florida station corn and cracked velvetbeans in various proportions were compared with corn alone as feed for pigs. In all cases the pigs made more rapid and cheaper gains on the corn and velvetbean mixture than on corn alone. In another test at this station shelled corn and soaked velvetbean meal were fed to three hogs, the proportion of velvetbean meal being gradually increased from one-fourth to two-thirds by weight. The hogs made very satisfactory gains, and it was found that the feed produced hard pork.

In a test made by the United States Department of Agriculture at the National Agricultural Research Center, Beltsville, Md., pigs that were fed soaked whole velvetbeans and shelled corn made an average daily gain of 0.586 pound. Pigs that were fed soaked ground velvetbeans alone made an average daily gain of 0.417 pound, and those that were fed soaked ground velvetbeans, shelled corn, and fish meal made an average gain of 1.15 pounds. Observations made during the test indicated that hogs did not like the taste of the beans.

At the Massachusetts station a ration composed of 20 parts by weight of velvetbean meal, 20 parts of high-grade peanut meal, 5 parts of corn meal, and 10 parts of alfalfa meal gave as satisfactory results as one composed of 80 parts of corn meal and 10 parts each of digester tankage and alfalfa meal. The addition of 10 percent of ground alfalfa to the grain ration for growing pigs, in order to supply the necessary vitamins, did not seem to have any marked effect in promoting growth.

Various feeding experiments with velvetbeans have been conducted at the Alabama station with swine. In one test five pigs, weighing on an average 62 pounds, were pastured on velvetbeans for 72 days; in addition, they received a half ration of corn four parts and tankage one part. They gained 1.23 pounds a day, each requiring two-fifths of an acre of velvetbeans and 170 pounds of corn and tankage to gain 100 pounds. In another test pigs that were fed on corn meal alone

gained 100 pounds at a cost of \$8.64, while those fed on equal parts of corn meal and ground velvetbeans gained 100 pounds at a cost of \$9.37. In a third test it was concluded that velvetbean pasture reduced by one-third the cost of gains in comparison with corn 10 parts and dried blood 1 part fed in dry lot.

At the Arkansas, Kentucky, and Michigan stations velvetbean meal as a part ration did not compare favorably with the other rations tested.

At the South Carolina station 40 hogs, weighing on an average 115 pounds, were grouped in four lots and used in tests of the comparative value of various methods of feeding velvetbeans. On the check ration of corn and tankage fed in dry lot, an average daily gain of 2.37 pounds per pig was produced at a calculated cost of \$9.51 per 100 pounds. The pigs receiving shelled corn and velvetbeans in the dry lot made an average daily gain of 1.81 pounds per pig at a calculated cost of \$11.04 per 100 pounds of gain. Another group similarly fed, except that the velvetbeans were soaked, made an average daily gain of 1.67 pounds per pig at a calculated cost of \$11.06 per 100 pounds of gain.

The fourth group, which hogged down a field of velvetbeans, made an average daily gain of 0.66 pound per pig at a calculated cost of \$8.26 per 100 pounds.

FOR HORSES

The Mississippi station reports that velvetbean meal mixed with corn or other grain is a satisfactory feed for horses.

In feeding tests at the Massachusetts station it was found that velvetbean meal, if sufficiently dry to prevent decomposition, may comprise some 20 percent of the grain ration, mixed together with 30 percent of oats, 40 percent of cracked corn, and 10 percent of wheat bran.

FOR POULTRY

The results of 4 years of experiments conducted at the North Carolina station in feeding velvetbean meal and ground velvetbeans to baby chicks and fattening broilers indicate that velvetbeans or velvetbean meal cannot be recommended in rations for fattening broilers or for baby chicks. When 22½ percent of ground velvetbeans was fed in the ration, it produced a deleterious effect on the health and performance of the birds.

VELVETBEANS AS HUMAN FOOD

Velvetbeans have been used to some extent as human food. In India the green seed of the Lyon velvetbean are considered by the natives a most excellent vegetable. The Yokohama variety is said to be eaten boiled by the Japanese; it has a taste similar to the horsebean or broadbean (*Vicia faba* L.) but, as it contains a slight amount of a poisonous ingredient, should be eaten in moderation. At the Florida station six persons tested the edibility of velvetbean seed prepared as baked beans. They were found to be very palatable but caused both purging and vomiting. The three persons who ate only about half as many of these beans as they would of baked navy beans were thus affected. The other three, who ate very sparingly, suffered no ill effects. In some sections of the Southern States it is stated that when the beans are boiled like peas and the water changed, they make an excellent food and produce no ill effects.

ENEMIES

The velvetbean is notably free from disease or insect enemies. The plants are entirely immune to the wilt caused by *Fusarium bulbigenum* Cke. and Mass. var. *tracheiphilum* that affects cowpeas, and only under very unusual conditions are they affected by the nema (*Heterodera radiculicola* (Freef) Nuell.) which causes root knot.

The velvetbean caterpillar (*Anticarsia gemmatilis* (Hbn.)) is the only insect which causes serious injury to the velvetbean. According to the Bureau of Entomology and Plant Quarantine, this insect is generally distributed throughout the tropical countries of America. The moth of this species does not winter in northern or central Florida but flies northward each summer from the southern end of the peninsula. It seldom appears farther north than central Georgia and rarely attacks the growing crop until about the time the plants are beginning to bloom. The moths usually make their first appearance in July in southern Florida, during August in central Florida, and during the last of August or early in September in northern Florida and southern Georgia.

The first appearance of the insect is marked by small holes in the leaves. At times the damage is very severe, all of the plants in large fields often being entirely defoliated and only the stems remaining. Little damage is done during the first 10 days or 2 weeks after the appearance of the moth, and it should not give much trouble on early varieties, which usually mature by the middle of September in northern Florida and southern Georgia.

The Florida station has been successful in combating this pest by dusting the vines with arsenate of lead or zinc 10 or 12 days after the first appearance of the moth. For this purpose 3 pounds of powdered arsenate of lead or zinc arsenite mixed with 12 pounds of air-slaked lime is sufficient for an acre. When this quantity is used there is no danger of poisoning stock pastured in the field, especially after one or two rains.

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